

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ US

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only	
Identification of IPEA	Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION	
Applicant's or agent's file reference 30794108WO01	
International application No. PCT/US03/39211	International filing date (day/month/year) 09 December 2003 (09.12.2003)
(Earliest) Priority date (day/month/year)	
Title of invention HIGHLY EFFICIENT GALLIUM NITRIDE BASED LIGHT EMITTING DIODES VIA SURFACE ROUGHENING	
Box No. II APPLICANT(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) THE REGENTS OF THE UNIVERSITY OF CALIFORNIA 1111 Franklin Street, 12th Floor Oakland, California 94607 United States of America	Telephone No.
	Facsimile No.
	Teleprinter No.
	Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) FUJII, Tetsuo 7240 Davenport Road, #104 Goleta, California 93117 United States of America	
State (that is, country) of nationality: JP	State (that is, country) of residence: US
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) GAO, Yan 705 Bolton Walk, #102 Goleta, California 93117 United States of America	
State (that is, country) of nationality: CN	State (that is, country) of residence: US
<input checked="" type="checkbox"/> Further applicants are indicated on a continuation sheet.	

Continuation of Box No. II APPLICANT(S)

*If none of the following sub-boxes is used, this sheet should not be included in the demand.*Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

HU, Evelyn L.
1160 North Fairview Avenue
Goleta, California 93117
United States of America

State *(that is, country)* of nationality:
USState *(that is, country)* of residence:
USName and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

NAKAMURA, Shuji
P.O. Box 61656
Santa Barbara, California 93160
United States of America

State *(that is, country)* of nationality:
JPState *(that is, country)* of residence:
USName and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*State *(that is, country)* of nationality:State *(that is, country)* of residence:Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*State *(that is, country)* of nationality:State *(that is, country)* of residence:☐ Further applicants are indicated on another continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: (Family name followed by given name; for a legal entity, full official designation.
The address must include postal code and name of country.)

GATES, George H.
 GATES & COOPER LLP
 6701 Center Drive West, Suite 1050
 Los Angeles, California 90045
 United States of America

Telephone No.

310-641-8797

Facsimile No.

310-641-8798

Teleprinter No.

Agent's registration No. with the Office

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***

1. The applicant wishes the international preliminary examination to start on the basis of:

☐ the international application as originally filedthe description ☒ as originally filed☐ as amended under Article 34the claims ☐ as originally filed☒ as amended under Article 19 (together with any accompanying statement)☐ as amended under Article 34the drawings ☒ as originally filed☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ Where the IPEA wishes to start the international preliminary examination at the same time as the international search in accordance with Rule 69.1(b), the applicant requests the IPEA to postpone the start of the international preliminary examination until the expiration of the applicable time limit under Rule 69.1(d).4. ☐ The applicant expressly wishes the international preliminary examination to start earlier than at the expiration of the applicable time limit under Rule 54bis.1(a).

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**

The filing of this demand constitutes the election of all Contracting States which are designated and are bound by Chapter II of the PCT.

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | | |
|--|---|-------|--------|
| 1. translation of international application | : | _____ | sheets |
| 2. amendments under Article 34 | : | _____ | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | 3 | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | _____ | sheets |
| 5. letter | : | 2 | sheets |
| 6. other (<i>specify</i>) | : | _____ | sheets |

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Examining Authority use only

received	not received
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<input type="checkbox"/>	<input type="checkbox"/>
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The demand is also accompanied by the item(s) marked below:

- | | |
|--|--|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 5. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> original separate power of attorney | 6. <input type="checkbox"/> sequence listing in electronic form |
| 3. <input type="checkbox"/> original general power of attorney | 7. <input type="checkbox"/> tables in electronic form related to a sequence listing |
| 4. <input type="checkbox"/> copy of general power of attorney; reference number, if any: | 8. <input checked="" type="checkbox"/> other (<i>specify</i>): Transmittal sheet (in duplicate); Return postcard |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

By: _____

George H. Gates

Date: 23 May 2005

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.☐ The applicant has been informed accordingly.4. ☐ The date of receipt of the demand is WITHIN the time limit of 19 months from the priority date as extended by virtue of Rule 80.5.5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.6. ☐ The date of receipt of the demand is AFTER the expiration of the time limit under Rule 54bis.1(a) and item 7 or 8, below, does not apply.7. ☐ The date of receipt of the demand is WITHIN the time limit under Rule 54bis.1(a) as extended by virtue of Rule 80.5.8. ☐ Although the date of receipt of the demand is after the expiration of the time limit under Rule 54bis.1(a), the delay in arrival is EXCUSED pursuant to Rule 82.**For International Bureau use only**

Demand received from IPEA on:

PCT

FEE CALCULATION SHEET

Annex to the Demand

International application No. PCT/US03/39211	For International Preliminary Examining Authority use only			
Applicant's or agent's file reference 30794108WO01	Date stamp of the IPEA			
Applicant THE REGENTS OF THE UNIVERSITY OF CALIFORNIA et al.				
CALCULATION OF PRESCRIBED FEES				
1. Preliminary examination fee	600. P			
2. Handling fee (<i>Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.</i>)	173. H			
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 773. </div>			
	<div style="border: 1px solid black; padding: 2px 10px;">TOTAL</div>			
MODE OF PAYMENT				
<table style="width: 100%; border: none;"> <tr> <td style="width: 40%; vertical-align: top;"> <input checked="" type="checkbox"/> authorization to charge deposit account with the IPEA (see below) <input type="checkbox"/> cheque <input type="checkbox"/> postal money order <input type="checkbox"/> bank draft </td> <td style="width: 60%; vertical-align: top;"> <input type="checkbox"/> cash <input type="checkbox"/> revenue stamps <input type="checkbox"/> coupons <input type="checkbox"/> other (specify): </td> </tr> </table>			<input checked="" type="checkbox"/> authorization to charge deposit account with the IPEA (see below) <input type="checkbox"/> cheque <input type="checkbox"/> postal money order <input type="checkbox"/> bank draft	<input type="checkbox"/> cash <input type="checkbox"/> revenue stamps <input type="checkbox"/> coupons <input type="checkbox"/> other (specify):
<input checked="" type="checkbox"/> authorization to charge deposit account with the IPEA (see below) <input type="checkbox"/> cheque <input type="checkbox"/> postal money order <input type="checkbox"/> bank draft	<input type="checkbox"/> cash <input type="checkbox"/> revenue stamps <input type="checkbox"/> coupons <input type="checkbox"/> other (specify):			
AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT <i>(This mode of payment may not be available at all IPEAs)</i>				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <input checked="" type="checkbox"/> Authorization to charge the total fees indicated above. <input checked="" type="checkbox"/> <i>(This check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)</i> Authorization to charge any deficiency or credit any overpayment in the total fees indicated above. </td> <td style="width: 50%; vertical-align: top;"> IPEA/ <u>US</u> Deposit Account No.: <u>50-0494</u> Date: <u>23 May 2005</u> Name: <u>George H. Gates</u> Signature: <u><i>George H. Gates</i></u> </td> </tr> </table>			<input checked="" type="checkbox"/> Authorization to charge the total fees indicated above. <input checked="" type="checkbox"/> <i>(This check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)</i> Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.	IPEA/ <u>US</u> Deposit Account No.: <u>50-0494</u> Date: <u>23 May 2005</u> Name: <u>George H. Gates</u> Signature: <u><i>George H. Gates</i></u>
<input checked="" type="checkbox"/> Authorization to charge the total fees indicated above. <input checked="" type="checkbox"/> <i>(This check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)</i> Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.	IPEA/ <u>US</u> Deposit Account No.: <u>50-0494</u> Date: <u>23 May 2005</u> Name: <u>George H. Gates</u> Signature: <u><i>George H. Gates</i></u>			

In re application of: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
International Application No.: PCT/US03/39211
International Filing Date: 9 December 2003
Agent's Reference: 30794108WO01
Title: HIGHLY EFFICIENT GALLIUM NITRIDE BASED LIGHT EMITTING
DIODES VIA SURFACE ROUGHENING

AMENDMENT UNDER ARTICLE 19
BEFORE THE INTERNATIONAL BUREAU OF WIPO

**VIA FACSIMILE
CONFIRMATION VIA FEDERAL EXPRESS**

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20
SWITZERLAND

Dear Sir or Madam:

In response to the Search Report dated 26 May 2004, please amend the above-identified application as indicated below:

IN THE CLAIMS

It is requested that the claims of the above-referenced application be amended as provided on replacement pages 16-18 attached herewith. No new matter has been introduced by these amendments. The claims correspond to the current PCT claims as follows:

<u>Claims</u>	<u>Status</u>
1-2	Amended
3-7	Unchanged
8	Amended
9-14	Unchanged
15-16	Amended
17-18	Unchanged

REMARKS

In view of the above amendments, it is submitted that the claims are in a condition for a positive examination report. If this is not the case, the Examiner is encouraged to contact the Applicant's representative since a positive report is requested.

Please direct any inquiry to the below-signed attorney.

Respectfully submitted,

GATES & COOPER LLP
6701 Center Drive West, Suite 1050
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(310) 641-8797

ATTORNEYS FOR APPLICANT(S)

Date: 22 July 2004

By: 
George H. Gates

WHAT IS CLAIMED IS:

1. A gallium nitride (GaN) based light emitting diode (LED), wherein light is extracted through a nitrogen face (N-face) of the LED and a surface of the N-face is roughened.

5

2. The GaN LED of claim 1, wherein the surface of the N-face is roughened into one or more cones.

3. The GaN LED of claim 1, wherein the roughened surface reduces light reflections occurring repeatedly inside the LED, and thus extracts more light out of the LED.

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4. The GaN LED of claim 1, wherein the surface of the N-face is roughened by an anisotropic etching.

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5. The GaN LED of claim 4, wherein the anisotropic etching is a dry etching.

6. The GaN LED of claim 4, wherein the anisotropic etching is a photo-enhanced chemical (PEC) etching.

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7. The GaN LED of claim 1, wherein the N-face is an n-type layer of the GaN LED.

8. The GaN LED of claim 1, wherein the N-face is prepared by a laser lift off (LLO) technique.

25

9. The GaN LED of claim 1, wherein the LED is grown on a c-plane GaN wafer and a gallium face (Ga-face) is a p-type layer.

10. The GaN LED of claim 1, wherein the LED is comprised of an n-type electrode, n-type layer, active region, p-type layer and p-type electrode.

5 11. The GaN LED of claim 10, wherein the n-type layer, active region and p-type layer are each comprised of a (B, Al, Ga, In)N alloy.

12. The GaN LED of claim 10, wherein the p-type electrode has a property of high reflection to decrease light absorption and to increase light reflection toward
10 the surface of the n-type layer.

13. The GaN LED of claim 10, wherein the LED includes a current-blocking layer aligned under the n-type electrode to keep the current from concentrating below the n-type electrode, so that absorption of light emission under
15 the n-type electrode can be avoided and extraction efficiency can be increased.

14. The GaN LED of claim 10, wherein the LED includes a current-confining frame made of an insulator to restrain leakage current through the sidewalls of the LED without significantly decreasing an emitting area.
20

15. The GaN LED of claim 2, wherein the roughened surface is comprised of a plurality of hexagonal shaped cones that have an angle equal to or smaller than:

$$2 \sin^{-1}(n_{air} / n_s) \approx 47.2^\circ$$

25 for GaN, where n_{air} is a refractive index of air and n_s is a refractive index of GaN.

16. The GaN LED of claim 2, wherein the roughened surface is comprised of a plurality of hexagonal shaped cones that have an angle equal to or smaller than:

$$2 \sin^{-1}(n_{enc} / n_s)$$

5 for epoxy, where n_{enc} is a refractive index of epoxy and n_s is a refractive index of GaN.

17. A method of creating a gallium nitride (GaN) based light emitting diode (LED), wherein light is extracted through a nitrogen face (N-face) of the LED,
10 comprising:

roughening a surface of the N-face into one or more cones.

18. A light emitting diode (LED) comprised of an n-type electrode, n-type layer, active region, p-type layer and p-type electrode, wherein a surface of the n-type
15 layer is roughened by an anisotropic etching into one or more cones and light is extracted through the roughened surface of the n-type layer.